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Original Article

Study on Physico-Chemical Analysis of Heavily Polluted Shivaji Talao and Its Impact On Aquatic Bodies

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ABSTRACT

Physicochemical characteristics of Shivaji talao was conducted to analyze ecological parameters like pH , CO_2, O_2,total hardness, salinity, phosphate, turbidity of water. The study revealed that pHvaluewas 8.5and it was same a year before , while dissolved oxygen was 0.67 mg/l .Carbondioxide content, salinity, phosphate ,turbidity and total hardness level increased .Study showed that water was not found to be suitable for aquatic animals due to high salinity content in the water.

Key words *:Shivajitalao, pH,Co_2, salinity,0_2*

INTRODUCTION

The surface water and groundwater resources of the country play a major role in agriculture, hydropower generation, livestock production, industrial activities, forestry, fisheries, navigation, recreational activities, etc. due to unplanned management, tremendous development of industry and agriculture and disposal of untreated public sewage water , agricultural runoff and other human and animal wastes into water bodies are continuously deteriorating the water quality and biotic resources (Venkatesan, 2007; Elmaci et al.,2008).These are the causative agents leading to eutropication (Chukwu and odunzeh 2006,Shekhar et.al 2008).Health of the water bodies and biological diversity are related to almost every component of the ecosystem. Six percent of earth is occupied by wetland. These land provide support to food web and gives services to nature and human being . Bhandup is one of the oldest suburbs in Mumbai and is a home to shivajitalao. Early people `use to depend on Shivajitalao Lake for their daily activities. Presently this lake is being considered as devotional lake , where many antropogenic activities are conducted in the name of God ,due to which lake is getting polluted day by day and the depth is also decreasing, itis also used as waste dumping ground. Drainages are **also** released into this lake. Study therefore was conducted to determine the present status of pollution and quality of water.

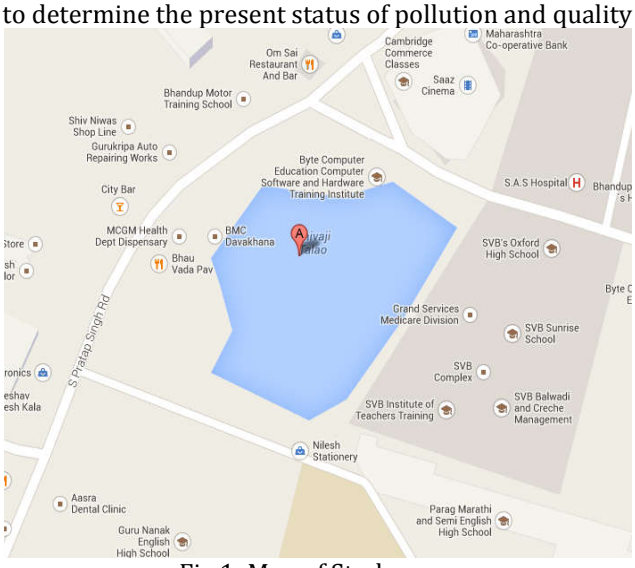

Fig 1: Map of Study area

MATERIAL AND METHODS

The samples were collected from two different sites of the lake. Surface Water samples were taken for analysis. The atmospheric temperature and water temperature were recorded with the help of mercury filled centigrade thermometer. The specific conductivity was determined with the help of conductivity meter (DREL 2000 HACH, USA) and expressed as µmhos/cm. The hydrogen ion concentration was recorded with the help of pH strips and digital pH meter. Total Alkalinity was analysed by titration method using strong acid and methyl orange and phenolphthalein solutions as indicators. Dissolved oxygen was determined by modified Winkler's method. Total hardness of water was determined by ethylene diamine tetra acetic acid (EDTA) titration method using Erochrome black-T as indicator. Phosphate was determined by inorganic phosphorous by using stannous chloride method. Biological oxygen demand was determined by Wrinkler'sIodometric method. Transparency of water samples were determined by using Secchi disc and colour by visual estimation.

Physico-chemcial characters of air and water temperature, transparency, colour, pH, dissolved oxygen, total hardness, total alkalinity were determined at the sampling sites immediately after the collection of water samples, while rest of the parameters were analyzed in the laboratory within a period of 6 hours after the collection of water samples .samples were fixed for DO and BOD and then brought to the laboratory for analysis. Water samples were analyzed for different parameters using standard methods (APHA, AWWA, WPCF 1981, Trivedi and Goel, 1984).

Reasons for undertaking this project:

This work is an attempt to create first hand information about the present situation and quality of water of Shivaji Lake.This will help the concerned authority to plan and take necessary remedial measures thereby a step to maintain one of the wetlands which can become a natural ecosystem for various fauna.

RESULTS AND DISCUSSION

During the period under study, different physio-chemical parameters were analyzed as per standard methods for the examination of water.

Atmospheric Temperature followed seasonal climatic pattern. Temperature varied between 28.0º C and 32.0 ºC was lowest in January and highest in June.

Water Temperature plays a very important role in some physiological processes like release of stimuli for breeding mechanisms in fish, both under natural and artificial conditions .(Hora, 1945; Chaudhuri, 1964) . Water temperature varied between 21.9^{0}C and 24.0 ^{0}C from August to July . In the present study highest water temperature was noted during summer season and lowest was recorded during the winter season. This observation has been true for several water bodies in India. (Narayana*et al.* 2008; Garg*et al.* 2009; Verma*et al.* 2011; Prabhakar*et al.* 2012 and MeenakshiSaxena (2012).

Transparency is considered as an important parameter of trophic status of water bodies. It depends on the intensity of sunlight, suspended soil particles, turbid water received from catchment area and density of plankton (Mishra &Saksena 1991). Transparency is inversely proportional to the amount of suspended organic & inorganic matter, density of the planktonic organisms and intensity of light. The turbidity range varied between 800 to 1000 mg/l due to suspension of garbages and devotional activities. The transparency of water was low during monsoon period (July to August), while water was more transparent in May . The water transparency started decreasing in the mid of June with the start of rainy season. The rain water not only brings the silt from the catchment area but also garbage and drainage water ; which decreases the transparency, after the rains the silt starts settling down. Low values of transparency were observed in Ganpatifestival due to accumulation of suspended matter (silt, clay and organic matter) into the water body .

Hydrogen ion concentration: pH indicates the intensity of the acidic or basic character of a solution and is controlled by the dissolved chemical compounds and biochemical processes in the solution. The pH>6.0 is indicative of low production, pH between 6.0 and 8.5 is of medium production and more than 8.5 is of high productivity in the water bodies. The largest fish crops are usually produced in water which is just on the alkaline side of neutral between pH 7.0 and 8.0. Shivaji on talao was found to be alkaline in nature. The range of pH ranged from 8.4 to 8.6 may be due to decomposition of allochthonous matter present which increase the nutrient concentration at higher temperature, input of sewage and anthropogenic waste are also responsible for higher values of pH in water. pH range from 6.4 to 8.3 is favorable for fish growth. In the present observation shivajitalao showed alkaline pH range throughout the course of study and can be classified under the category of alkalliphious water bodies.

Total Alkalinity: Alkalinity of water is a measure of its capacity to neutralized acids and the total alkalinity is the total sum of carbonate and bicarbonate alkalinities. It is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates, borates, silicates etc. along with hydroxyl ions available in Free State. The high alkalinity can be attributed to increased rate of organic decomposition during which

free carbon dioxide is liberated and reacts with water to form bicarbonates thereby increasing the total alkalinity (Goel*et al.* 1984). All the ponds above 90.0 ppm of total alkalinity have been found to be productive. In shivajitalao the maximum value of the total alkalinity was recorded to be in range of 500 mg l^{-1} in summer and in winter season. it could be due to decrease in death and decay of plants and living organisms.

Dissolve oxygen The dissolved oxygen play a role of regulator of metabolic activities of organisms and thus governs metabolism of the biological community as a whole and as used as an indicator of trophic status of the water (Saksena & Kaushik 1994).In shivajitalao the low value of the Dissolve Oxygen was recorded to be 2.7 mg $l^{-1.}$,this was due to the poor photosynthesis activities resulting into less oxygen.

Total hardness Total hardness is defined as the concentration of multivalent metallic cations in solution. Bicarbonates and carbonates of calcium and magnesium impart temporary hardness, whereas, sulphates, chlorides and other anions of mineral acids produced as permanent hardness. Sawyer (1960) classified water bodies on the basis of hardness into three categories,viz., soft (hardness less than 75.0 mg l^{-}), moderately hard (from 75.0 - 150.0 mg l^{-1}), and hard (from 151.0 - 300.0 mg $\mathbf{l}^{-1}$).

The maximum value of the total hardness in Shivajitalao was recorded to be 280 mg l^{-1} are probablydue to the addition of large quantities of sewage and detergents in the water from the nearby residential localitieswith surface runoff water. Shivajitalao water is adjudged as hard water throughout the study period.

Phosphate: Phosphorous is considered to be the most significant component among the nutrients responsible for eutrophication of a water body, as it is the primary initiating factor. High concentrations of phosphates can indicate the presence of pollution and are largely responsible for eutrophic conditions. Lee et al (1981) have classified the water bodies on the basis of phosphorus contents into five categories,viz., oligotrophic, oligo-mesotrophic, mesotrophic, meso-eutrophic; eutrophic. Phosphorus is rarely found in high concentrations in freshwaters as it is actively taken up by plants. Ecologically phosphorus is often considered as the most critical single element in the maintenance of aquatic productivity. The main source of phosphorous in water comes from the weathering of phosphorous bearing rocks, leaching fromsoils of nearby catchment areas and cattle dung. Other factors regulating the phosphorous are such as bacterial activity,sewage contamination, agriculture fertilizers, industrial effluents, depth of water body, aquatic vegetation, bottomfauna, dead eggs of aquatic animals and excreta of other animals etc. Lee *et al.* (1981), on the basis of phosphorus contents have classified the water bodies into five categories, viz., oligotrophic less than 0.007 mg L-1,oligo-mesotrophic between 0.008 and 0.011 mg L-1, mesotrophic between 0.012 and 0.027 mg L-1, meso-eutrophicbetween 0.028 and 0.039 mg L-1, eutrophic more than

0.040 mg L-1.In the present study, Shivajitalao showed maximum value of phosphrous content as 1.46 mg l^{-1} in monsoon and minimum is 1.12 mg l^{-1} in winter. Surface runoff from washings of garbages and mixing with the drainage water made higher values of phosphorous in the lake. When the criterion of inorganic phosphorus is applied, Shivajitalao can be placed under eutrophic water body (Lee et al. 1981). From the above data, it can be concluded that high fish production can be expected as phosphorus concentration is above 0.02 ppm.

Biological Oxygen Demand: Biochemical Oxygen Demand is a very important parameter in estimating the pollution status of sewage and industrial waste in the water body. In itself BOD is not a pollutant and exercises no direct harm but it may cause an indirect harm by reducing dissolved oxygen concentration levels inimical to fish life and other beneficial uses. BOD represents that fraction of Dissolved Organic matter which is degraded and easily assimilated by bacteria. The values of BOD provide information regarding quality of water and helps in deciding the suitability of water for consumption. It indicates the presence of biodegradable organic matter quantitatively, which consumes dissolved oxygen from water. The higher values of BOD produce obnoxious smell and unhealthy environment. Its range varied from 4.2 to 4.8 mg/l. The higher values of BOD were noted during summer months due to favourable environmental conditions for microbiological activities at higher temperature..Biological oxygen demand is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water. It also indicates the presence of microbial activities and dead organic matter on which microbes can feed. In the present study the biochemical oxygen demand during entire period was ranging from 4.2 mg l to 4.8mg l. A higher value of biochemical oxygen demand indicates maximum consumption of oxygen in mitigating higher organic pollution load. In the present investigation, the values of biochemical oxygen demand were obtained may be due due to lesser quantity of organic material in the form of solids and decreased microbial population. Similar observations have been made by Garg et al (2006), Karne&Kulkarni (2009) and Verma et al. (2012) on various water bodies.

Tropical status of the water body: Nutrient level of any water body is directly related with their tropic status.Both natural and anthropogenic factors influence the productive status and water body's tropic

status.There have been good number of parameters of water which are used to designate tropic status of water bodies.Shivaji lake was considered to be eutropic water body which was due to the fact that sewage is discharged and also due to human devotional practices are done in the vicinity (Garg et.al. 2006) .On the basis of physiochemical characteristics conducted and from the evaluation status it can be stated that shivaji lake can be placed under eutropic.

CONCLUSION

Colour of the lake water rangedfrom light brown could be due to devotional activities .Talao can be classified under the category of **alkalliphious**. High values of salinity and less dissolved oxygen is not suitable for survival of living forms as fishes require at least 4-6 mg/l of DO.Nutrient levels indicate that the water is good enough for existence of algae and other aquatic plant species.

During the survey it was found that the garbage from slum areas and other places are dumped into the lake. Drainage is also released into the lake which adds to the reasons of pollution and can prove to be detrimental for the ecosystem. The development and planning of this nature gifted "wetland" should be sensitive towards the environmental aspects. Awareness has to be created regarding the future problems and importance of wetlands for common public and concerned authorities.

Table 1: Physico-chemical characteristic of Shivajitalao water

	parameters	**Min**	**Max**	**Mean +SE**
1	Ambient Temperature (C)	28	32	±4.78
2	Water Temperature (C)	21.5	24.8	22.8±1.34
3	Turbidity	804	1000	937.5±12.9
4	pH	6.0	8.5	7.1±`1.39
6	Total Alkalinity	492	509	486.6±14.44
7	Dissolved Oxygen	2.1	2.9	2.3±1.8
8	BOD	4.2	4.8	4.57±0.66
9	Total Hardness	126	280	138.9±10.92
10	Phosphate	1.16	1.42	1.34±0.01
11	salinity	412	489	455.5±54
12	Colour	Light brown	Light brown	Light brown

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